A Literature Review on Wind Analysis of Tall Building With Vertical Setback For Different Height & Area Ratio

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Abstract- *The Tall building is being used as much as possible, to live, to commercial and to make statue. It will be of all the building different shapes, design and Structure. From this point of view any building having different discontinuity in mass, geometry of Structure and stiffness. This discontinuity impart the irregularities in the structure. The collapse of high rise building due to irregularities like in symmetries of mass, stiffness, height ratio and geometry of structure. To keep this needs for a long time, we must find out the permissible irregularities to get the maximum building strength/ building life. For design of tall building we need to consider both wind load. So, the effect of vertically irregularities in the wind analysis performance of structure becomes really important.*

Now I will study about behavior of high rise building with different vertical setback and Area ratio on different models of moment resisting rigid frame structure with optimum location of shear wall.

Keywords- Vertical setback, Stiffness, Mass irregularities, Story drift, Displacement, Base shear, ETABS

I. INTRODUCTION

The building which have been in irregular category and failure of structure can take place by discontinuity in geometry, mass, load resisting and lacks symmetry building. Irregular structure contribute a large portion of urban infrastructure. Height wise changes in Overturning, storey displacement, mass deflection and stiffness. The structure irregularities can be broadly categorized as horizontal (plan) and Vertical irregularity. The vertical irregular structure, the irregularity in the building structures may be due to irregular distributions in their mass, strength and stiffness along the height of building are constructed in high seismic zones, the analysis and design becomes more complicated. The different types of vertical irregularity are Stiffness Irregularity (Soft Storey), Mass Irregularity, Vertical Geometric Irregularity, In-plane Discontinuity in vertical element resisting lateral load, Strength Irregularity (Weak storey), Floating or stub columns, Irregular modes of oscillation in two principal plan direction. From different types of irregularity the project is taken on Vertical Geometry irregularity. The horizontal plan is resisting system in a storey is more than 150 of that in its adjacent storey. Then the structure is considered to be Vertical geometric irregularity. A rigid frame bent with setback which can be analyzed approximately by applying the cantilever method to the upper and lower part as though they were two separate frame. A moment distribution is then carried out for the setback girder supported on the lower column and subjected to the calculated vertical forces from the column of the upper structure. Because the setback girder is so much stiffer in bending then the column . It may be assumed for this part of the analysis that the girder rests on simple support. The moment distribution yield the girder moment and shear and, hence, the vertical forces that the girder applies to the supporting column; these forces are assumed to carry all the way to the foundation. In addition to its story increments of wind load, a concentrated horizontal load at the setback level equal to the total horizontal force above that level. The column axial force calculated from the moment of the external horizontal loading are added to those determined from the setback beam distribution to start the cantilever analysis for the cantilever analysis for the lower part. The total moment and shear in the setback at girder due to wind forces are the superposed result of the three analyzes: the cantilever analysis of the upper part, the cantilever analysis of the lower part, and the moment distribution of the girder. If the complete setback structure has a low height-to-width ratio, it would be more appropriate to use the portal method of analysis. As described above, the two part of the structure would be analyzed separately with the total shear from the upper structure applied as a concentration load at the setback level for the analysis of the lower structure.

II. LITERATURE REVIEW

1) M. S. Azad, M. M. Sazzad, N. Samadder, M. F. Rahman (2019) Performed pushover analyses to find the capacity of building and to define the limit states of damages. Fragility

curves are developed to see the differences due to the setbacks. It should be noted that all buildings are with the same heights of 18 meters and same land areas of 400 square meters. The Pushover curves and fragility curves demonstrate that setbacks have considerable effects on the wind capacity of structures. Pushover analysis is an approximate approach of analysis to assess the structural capacity. The linear and nonlinear states of responses of the structures. It overlooks the inertia forces and damping forces and so fragility curves are developed to observe the inertia effects as well. Pushover analysis, the effects of location of setbacks are negligible. On the contrary, the fragility curves and probability curves are not closer because of the influences of inertia and induced torsion due to the irregularity.

2) Milind V. Mohod 1, Nikita A. Karwa (2018) undertaken the analytical studies involved design of different building geometries were taken for the study. Depending on result obtained for all the models variations in nodal displacement and story drift are presented in Result & Discussion. The different Critical setback ratio shows the variation in story drift which signifies the jumping of the forces due to unequal distribution of mass along the plan as well as along the height. The optimum value of critical setback ratios mainly RA and RH comes out to be RA=0.75 and RH=6/5. Above value complies with the criteria given in IS 1893 for considering the structure to be irregular. It concluded that a the revision of seismic codes provisions for geometric vertical irregularities seems to be essential to stipulate more restrictive limits or apply more accurate analytical procedures to predict the seismic performance of setback structures under the seismic excitations, especially for structures with critical setback ratios.

3) Shaikh Abdul Aijaj Abdul Rahman, Ansari Ubaidur rahman Salik(2018) The present Work research attempts to investigate the proportional distribution of lateral forces evolved through seismic action in each storey level due to changes in mass of frame on vertically irregular structures. In this paper effect of mass irregularity of G+10 storey vertical geometric irregular building using finite element method based software ETABS is studied. Two methods of analysis namely linear static and linear dynamic analysis are used to evaluate response of Structure in the form of Storey shear, Storey displacement and storey drift. Response are plotted and compared.

4) Ilham Salehi, Dr. Raman Nateriya(2018) object of the work is to evaluate the seismic behavior of vertical irregular building frame as it begins form irregular and end to regular structure. For this purpose, 10 frames of multi-story buildings are considered. To study the behavior, the response parameters selected are displacement, story drift, as well as base shear and peak story shear, all the frames are assumed to be located in zone 5, for analysis STAAD.PRO software is used. For all vertical irregular frames with setback considered, displacement value top node displacement in case of irregular frames in more than that of the RB, except for IR5, IR6, IR7, IR8 and IR9. In case of setback irregular frames, a sudden extreme change in story drift due to setback has been observed, Peak story shear for irregular structures is less than regular structure but for IR 9 its higher than regular building. Story shear fall down at the setback level.

5) Akhilesh rathi, Dr. Ashwin Raut (2018) carried out the reinforced concrete framed structure designed for setback and regular building of loads (DL, LL & EL). The behavior of 20-Storied buildings with and without setbacks was studied. The buildings were analyzed using Time History Analysis and Response Spectrum Method and. Novelty. The effect of Setback is studied considering the parameters such as Time Period, storey drifts, Displacements, Storey Shears, Bending Moments and Shear Forces and correlated with the building without a setback. Period of setback buildings are found to be always less than that of similar regular building. Fundamental period of setback buildings are found to be varying with irregularity even if the height remain constant. The change in period due to the setback irregularity is not consistent with any of these parameters used in literature or design codes to define irregularity.

6) Rahul, Shivanand C G(2017) Present the behavior of the setback building and comparing them with the building without setback building (Regular building) under the lateral load. a) From the study ,The building with irregular structural configuration are subjected to serve damage when compared to the regular structure. b) During earthquake structure located in zone 2 are less affected when compared to the structure located at zone 5. c) There is difference in the base shear in all models this is due to the seismic weight of the building. d) The storey lateral displacement of mass irregular frame will increases in the building s. Regular frame has the least displacement.

7) Shashiknath H, Sanjith J, N Darshan(2017) Works on comparative study on regular building and irregular building under wind load. Result may come out that a). The geometrically irregular building experiences same base shear 1298.623 KN but has larger inter storey drifts due to offset provided at the inter stories. b). In case of geometrically irregular structure, structure with offset at lower storey shows higher storey displacement of 0.02345mm when compared with other three models of 0.0207mm and 0.01123mm. c). Structure without geometrical irregularity of 0.01549mm

shows very little amount of displacement when compared with the structures with geometrical irregularity 0.02345mm, 0.0207mm 0.01123mm.

8) Firoja Alam, Shree Prakash (2017) analyzed the asymmetric multi-storied building. It shows that there is increase in shear force due to torsion in column and increase in area of steel reinforcement in column particularly at the edge member of the building. Setback buildings are characterized by staggered abrupt reductions in floor area along the height of the building, with consequent drops in mass, strength and stiffness. Many investigations have been performed to understand the behavior of irregular structures as well as setback structures and to ascertain method of improving their performance. Here an attempt has been made to study the behavior of different structures of reinforced concrete with different heights with and without shear walls. Coupled shear walls have also been studied to understand the comparative merit or demerit of framed structures with shear wall structures. Studies have been carried out on sample model structures and analysis has been carried out by ETABS software.

9) Sharon Esther (2017) investigate analytical model Ascending and Descending buildings have been generated and analyzed using structural analysis tool "STAAD. Pro." To study the effect of varying height of columns in top storey due to Architectural purpose. The analytical model of the building includes all important components that influence the mass, strength, stiffness, and deformability of the structure. The deflections at each storey level has been compared by performing response spectrum method has been performed to determine capacity, demand and performance level of the considered building models.

10) Mahmud Sazzad(2015) Present a numerical study of the effect of building shape to the response of earthquake, The result depicts that the shape of building has noticeable effect in minimizing the drift of building and displacement due to earthquake loads.

11) Aashish Kumar, Aman Malik, Neeraj Mehta(2015) carried out to find out lateral storey displacement of different three types of models (nine cases) with constant in bay length i.e. 5x5m and with change in storey height is examined. Nodal displacement criteria were considered for the best value of critical set-back ratio. The most favorable value of set-back ratio comes out to be A/L=0.75 and H=8/25 where nodal displacement value are affect structure in small amount with comparison to other set-back ratio values. The irregular structures have to be treated with proper understanding and by following the codal provisions given in the code. It also examined that a the revision of seismic codes provisions for geometric vertical irregularities seems to be necessary to specify more restrictive limits or apply more exact logical procedures to calculate the seismic performance of set-back structures under the seismic excitations, mainly for structures with critical set-back ratios.

12) Nonika. N, **Gargi Danda De (2015)** examine to understand the effect of elevation irregularity and behaviour of R.C. Building for different zones. The study consist a 5 bays X 5 bays, 16 storied structure with provision of lift core walls and each storey height 3.2 m, having irregularity in elevation. Linear dynamic analysis using Response Spectrum method of the irregular building is carried out using the standard and convenient FE software package. The analyzed parameter are Maximum displacement, Base shear & Time period. Base shear and lateral displacement will increases as the seismic intensity increases from zone-2 to zone-5 which indicates more seismic demand the structure should meet. The drift is observed in the storey in which the stiffness is reduced. As stiffness increases frequency of the structure increases.

13)Suchita Hirde, Romali Patil(2014) The performance of building under seismic force can be improved by providing lateral load resisting element such as shear walls. There is increment in base shear for all models incorporated with shear wall, this due to increase in seismic weight of building. Shear walls are found to be very effective in reducing the lateral displacement in setback buiding.

14) S.Varadharajana, V. K. Sehgal, B. Saini (2014) proposes an irregularity index for quantifying the setback irregularity based on the dynamic characteristics of the buildings. The equation for the fundamental period of vibration, for building frames with setback irregularity. The equations for estimating the maximum inter storey drift ratio (Ir) and maximum displacement ductility (μmax) are also proposed. These equations are proposed on basis of the regression analysis conducted on the seismic response databank of 305 building models with different types of setback irregularity for each height category. The proposed equations are represented as a function of the irregularity index, and are validated for 2D and 3D building models with setback irregularity.

15) Rajeeva and Tesfamariam (2012) The Fragility based seismic vulnerability of structures with consideration of soft - storey (SS) and quality of construction (CQ) was demonstrated on three, five, and nine storey RC building frames designed prior to 1970s. Probabilistic seismic demand model (PSDM) for those gravity load designed structures was developed, using non-linear finite element analysis,

considering the interactions between SS and CQ. The response surface method is used to develop a predictive equation for PSDM parameters as a function of SS and CQ. Result of the analysis shows the sensitivity of the model parameter to the interaction of SS and CQ.

16) Sarkar et al. (2010) proposed a new method of quantifying irregularity in vertically irregular building frames, accounting for dynamic characteristics (mass and stiffness). The salient conclusions were as follows: A measure of vertical irregularity, suitable for stepped buildings, called regularity index‘, is proposed, accounting for the changes in mass and stiffness along the height of the building. An empirical formula is proposed to calculate the fundamental time period of stepped building, as a function of regularity index.

17) Karavasilis et al. (2008) studied the inelastic seismic response of plane steel moment-resisting frames with vertical mass irregularity. The analysis of the created response databank showed that the number of storey’s, ratio of strength of beam and column and the location of the heavier mass influence the height-wise distribution and amplitude of inelastic deformation demands, while the response does not seem to be affected by the mass ratio.

18) Athanassiadou et all,(2008) concluded that the effect of the ductility class on the cost of buildings is negligible, while performance of all irregular frames subjected to earthquake appears to be equally satisfactory, not inferior to that of the regular ones, even for twice the design earthquake forces. DCM frames were found to be stronger and less ductile than the corresponding DCH ones. The over strength of the irregular frames was found to be similar to that of the regular ones, while DCH frames were found to dispose higher over strength than DCM ones. Pushover analysis seemed to underestimate the response quantities in the upper floors of the irregular frames.

III. CONCLUSIONS

On the study of above different research papers on conclude the following point.

- The different research can and analyzed the different irregularities i.e. Vertical and Horizontal irregularities. Due to the tall building generally vertical irregularities are more essential then horizontal irregularities as per the above research paper.
- The irregularities in the structure is affect the different parameter of building. The parameter are height ratio, Stiffness, Storey mass, Mass irregularities, shape of building, base shear etc.
- On the above research paper the different research are used different method of analyzed to get the result on behalf of irregularities.
- The analyzed are based on earthquake and wind method of static as well as dynamic approach.

IV. FUTURE WORK

- Comparison between different structural form of multistory building in vertical setback irregularities with different proportional of height.
- Horizontal irregularities with different proportional of height.
- Comparative study of ratio of floor area of setback.
- Missing of software programming to get Quick and direct output of different parameter of building which are affected by irregularities

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